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KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: FISKERI · BIND I

Nr. 1. C. G. Joh. Petersen: ON THE LARVAL AND POSTLARVAL STAGES OF THE LONG ROUGH DAB AND THE GENUS *PLEURONECTES*. (WITH 2 PLATES)

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI
1904

MEDDELELSER

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KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: FISKERI

BIND I

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August 1904

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MEDDELELSER FRA KOMMISSIONEN FOR HAVUNDERSØGELSER
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ON THE
LARVAL AND POSTLARVAL STAGES
OF
THE LONG ROUGH DAB
AND
THE GENUS *PLEURONECTES*

BY

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(WITH 2 PLATES)

KØBENHAVN
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Among the large collections of young pelagic and half-pelagic fishes, which Dr. Johs. Schmidt brought home from his cruise with the steamer "Thor" to Iceland and the Fœroe Isles in 1903, there was a considerable number of young specimens belonging to the flounder-family. In these I took a special interest, having tried already in 1893 to give "Some zoological characters applicable to the determination of young (post-larval) Flat-fishes" in "Beretning IV fra den danske biol. Station", Tillæg II (Danish & English text)[1]). From an investigation of the entire material, it appeared that several series of less well-known stages might be procured, and that the literature dealing with this subject, published since 1893, frequently showed doubtful and inaccurate identifications whilst these series now gave clear and conclusive information. The misapprehensions are especially due to the insufficient material which the different authors have had at hand, for which reason I think that a representation of whole series, such as I shall try to set forth in the following with regard to several of the disputed species, will serve to enlighten former mistakes and to avoid future ones. In my above-named paper I have myself been unable to avoid a misapprehension, having taken a young fish of the flounder-family sent by R. Collett in Norway for the young of the ordinary halibut, whilst in reality it was a young *Pleuronectes cynoglossus*. This matter can now be determined with certainty. Holt has already done so in „Scientific Investigations, Ireland", but at that time the determination was all uncertain for want of series, the young one cited being all that was known in the entire North of the young *Pleuronectes cynoglossus*. The larval halibut is still unknown, unless the second young one represented by me in „Beretning IV" as a *Hippoglossus hippoglossoides* from Greenland (fig. 21), and which evidently is pelagic in spite of its 51^{mm}'s length, should be a larva of the ordinary halibut. Its bad preservation makes it impossible to count the dorsal fin-rays with any accuracy, and in the anal-fin it is only possible to count 70 rays, so it may just as well be ascribed to *H. vulgaris* as to *H. hippoglossoides* (see p. 5). Consequently, this case will for the present have to be left unsettled.

It is above all, the young *Drepanopsetta platessoides* which have given rise to the many mistakes in literature because they have been known so little; as moreover these young ones are so abundantly represented in the "Thor"'s collections I shall begin with a closer reference to them. With regard to the newer literature dealing with the flounder-fishes, I shall in general but refer to "Publications de Circonstance No. 3. Conseil perm. intern. pour l'exploration de la mer", and especially mention the following names: Holt, M'Intosh, Masterman, Cunningham, Ehrenbaum, Kyle etc. I shall begin by setting forth some preliminary remarks regarding the pigmentation of the *Drepanopsetta* and the *Pleuronectes*-species especially dealing with the dark[2]) pigment-groups which remain on the young specimens preserved in formalin.

[1]) The term larval fish comprises in this treatise all fishes which are not yet in form and other characters, size and maturity of the sexual organs being disregarded, in accordance with the grown up fish.

[2]) I call on purpose the pigment dark, not black, because it appears so when we look at the fishes through an ordinary lens. When the fish were living, the pigment was frequently not black at all but chocolate-brown, as for instance, that of *Pleuronectes cynoglossus*. As the opportunity of seeing such larval fishes in a living state does not present itself as a rule, I have by illustrations and descriptions tried to characterize them as they look in the collections. I have had them drawn mostly by reflected and not by transmitted light; they have not been cleared up in zylol or in similar fluids because all interior organs as vertebræ, brain, heart, etc. generally are of inferior importance in the determination. Sometimes it may however be necessary to consider the number of the vertebræ, but I always first try to determine the fishes by external characters, which do not require any special preparation.

Our collections of recent years are preserved in 2 % formalin which has shown excellent powers of preservation. The arrangement of the pigment-groups of the postanal part of the fish may evidently, in all the species of *Pleuronectes* in Northern Europe as well as in *Drepanopsetta*, be retraced to the original type which is found in *Pl. cynoglossus* (see figs. 22—26, Pl. II), but in *Pl. platessa*, *flesus* and *limanda* the pigmentation of the smaller larvæ is not conspicuous enough to point out the type. Not till about the metamorphosis especially in the bottom stages, will the arrangement of the spots in these 3 species show itself to be on the whole in accordance with that of *Drepanopsetta*. For this reason I shall at present leave these 3 species out of consideration.

The fundamental type of the pigmentation is that which can be observed in the quite young *Pl. cynoglossus* of c. 6^{mm} (se pl. II, fig. 22), namely three postanal pigment-groups 1, 2 and 3, extending over the trunk but not over the fins; the farthest back is 1, which later on belongs only to the caudal fin. Near the anus appears quite ventrally a fourth group 4. Between these 4 groups the distances are nearly equal. Between them three other pigment-groups appear, *a*, *b* and *c*, of which *c* is the foremost, *a* the farthest back, yet they are all three ventral. These have also about the same distance from *a*—*b* and from *b*—*c*, and they are situated half way between the four previous groups. The whole arrangement will therefore be this:

caudal tip 1 a 2 b 3 c 4 anus.

The anal-group excepted, these I groups remain for a long time undivided in *Pl. cynoglossus* (see Pl. II, figs. 23—27) and are not till late joined by other groups. In *Drepanopsetta* (see pl. I, figs. 4—5) the same type is represented, but the two ventral groups *a* and *b* are very faint, *c* on the contrary more conspicuous and at later stages (see Pl. I, figs. 6—7) 2 and 3 and *c* are divided into a dorsal and a ventral group, while *a* and *b* quite disappear. We then arrive at the subjoined arrangement:

$\overline{1}$ $\overline{2}$ $\overline{3}$ $\overline{c}$ 4 anus.

c is easy to distinguish by observing that its distance from 3 and 4 is less than the distance between 1 and 2 and 2 and 3.

In *Pl. microcephalus*, the groups 1, 2 and 4 appear easily recognizable on the just hatched larva (see Pl. II, fig. 15), but the distance between 1 and 2 is a little shorter than that between 2 and 4. Besides these a ventral group appears between 2 and 4, which I explain as a *b* and not as a 3 group, supposing this last one to be quite wanting. We then arrive at the following arrangement:

$\overline{1}$ $\overline{2}$ $\overline{b}$ 4 anus.

However, *a* very soon makes its appearance and divides together with 2, *b* and 4 each into a dorsal and a ventral group (see Pl. II, figs. 17 & following), in which way besides the corresponding groups on the fins we obtain

$\overline{1}$ $\overline{a}$ $\overline{2}$ $\overline{b}$ $\overline{4}$ anus,

apparently the same arrangement as that of *Drepanopsetta* (see Pl. I, fig. 7). The development, however, shows the 4 double groups to be not all homologous with the 4 in *Drepanopsetta*, if this term may be used of such transitory things as pigment-groups. The distances between the four groups I always found to be equal in *Pl. microcephalus* in the later stages, but as previously mentioned this is not the case with *Drepanopsetta*. It also appears that the illustrations in the literature have not all been carried out quite accurately, and this may sometimes cause a doubt as to their correct determination.

In order to orientate with regard to the number of the dorsal- and anal-fins rays of different flounder-fishes I add a scheme extracted partly from Smitt, Collett, Moreau, Cunningham and partly from my own investigations. S., C., M. Cu. and P. indicate the names of the different authors.

	Number of Rays in the dorsal fin	Rays in the anal fin
Hippoglossus vulgaris	110—98 S.	85—73
„ hippoglossoides (pinguis)	102—92 C.	76—71 S.
Drepanopsetta platessoides	101—76 C.	79—60
Pleuronectes limanda	80—65 S.	62—50
„ flesus	65—51 P.	46—34
„ platessa	80—57 P.	61—43
„ microcephalus	98—85 S.	76—70
„ cynoglossus	120—96 S.	102—86
Arnoglossus grohmanni	90—84 M.	67—55
„ laterna	93—83 S.	71—59
Zeugopterus boscii	82—75 M.	66—62
„ megastoma	91—85 S.	75—67
„ unimaculatus	80—70 M.	68—65
„ norvegicus	84 Cu.—83-74 S.	68—63 S.
„ punctatus	101—87 S.	89—67
Rhombus laevis [1])	83—67 S.	63—50
„ maximus	64—57 S.	47—42

Drepanopsetta platessoides.

Drepanopsetta must, in consequence of its distribution, be regarded rather as an arctic fish; according to HEINCKE it is not frequent at Heligoland and does not appear at the coasts of France (MOREAU). Its spawning-time in Denmark is early in spring.

In "Trans. Roy. Dubl. Soc. N. S., Vol. V, 1893, Pl. VII, figs. 57—61" HOLT described its eggs and newly hatched young with excellent illustrations. In "13. Ann. Rep. Fishery Board for Scotland pg. 220, Pl. VI—VII, 1895" its eggs and larvæ were again described by M'INTOSH. His Fig. 3, Pl. VII is a beautiful representation of a larva whose yolk is almost absorbed and showing, like Holt's larvæ, the 5 peculiar pigment-groups, three on the tail, one in the anal region and the fifth in front of the anus near the stomach (see my Pl. I, fig. 5). By this pigmentation and by the presence of a distinct pre-anal "embryonic fin" this young one is easily distinguished from all others at the same stage. It is on the whole a common occurrence that the young ones are better known in the early stages than later on, because they can be obtained by hatching from eggs in the laboratory, whilst the older ones have to be caught in the sea and we often only have a few more or less defect specimens at hand. APSTEIN too, represents in "Wissenschaftl. Meeresunters. N. F., II. Bd., 1897, Taf. II, fig. 11—13", the earlier stages and the egg in easily recognizable illustrations from individuals captured and dead, so these young *Drepanopsetta* may as a rule, be said not to have afforded insurmountable hindrances to the authors. The later stages that have not been hatched have done so to a high degree. I shall not mention all misapprehensions in the older literature, especially not when the authors themselves in their later works have acknowledged them, but I shall restrict myself to the newer literature.

[1]) Hybrids between these two species may possibly be found.

In "Food Fishes Pl. XV, figs. 10—11", M'INTOSH represents two young larval forms of the flounder family, the one of 10,37mm from HOLT's fig. 120, the other of 8mm; this latter has been taken from M'INTOSH and PRINCE's older work. He supposes both fishes to be "probably" *Pl. microcephalus* as determined by HOLT and PRINCE; however if they do belong to this species they must have been defective to such a degree that they have lost all the characteristic dots on the marginal fins; again, neither their head nor tail ressemble the *Pl. microcephalus* beautifully represented by M'INTOSH in "Food-fishes".

M'INTOSH's fig. 12 "Food-fishes Pl. XV", is so far as I understand "a little less than half an inch", consequently of about the same size as his fig. 10. I feel rather inclined to think that the two fishes from which figs. 10 and 11 in "Food-Fishes" were drawn, both belong to *Drepanopsetta* and not to *Pl. microcephalus*.

In "Marketable Marine Fishes 1896, pg. 244" CUNNINGHAM mentions the eggs and very small young ones of *Drepanopsetta* and adds moreover pg. 247: "Of the transformation stages we know nothing with certainty at present, for among the minute specimens of flat fishes collected at sea, this species has not been identified, at least not to the present writer's satisfaction." The justice of this opinion I quite recognize. CUNNINGHAM for this reason only illustrates a completely transformed postlarval fish after HOLT.

From Heligoland EHRENBAUM only mentions the eggs of *Drepanopsetta* in his paper of 1900 ("Wiss. Meeresunters."); they seem to be rare, which is in accordance with the rare appearance of the grown up *Drepanopsetta* there.

In the "16. Ann. Rep. Fishery Board for Scotland 1897" pg. 225, KYLE has determined a number of young *Pleuronectidæ* from the collections carried on for years by M'INTOSH; of some he gives sketches and among these of *Drepanopsetta* (see l. c. Pl. X—XI, figs. 17—26). His figs. 17—26 comprise young ones from 4,5mm—20mm, but as his "Drawings were intended as aids to the separation of the different species, only the necessary details were drawn". The drawings of the youngest specimens of *Drepanopsetta* especially show very few details which is probably due to the state of preservation. As these drawings up to date, seem to be the only reliable representations of *Drepanopsetta* during the transitional stages from pelagic to bottom-life, with exception of my two outline-figures in "Beretning IV fra den danske Biol. Station, Fig. 18 and 19, Tavle I", these stages may well demand more attention, especially as KYLE has only partly engaged himself in removing the mistakes which may be traced from paper to paper in the literature relating to this subject, f. inst. those of HOLT.

The first author describing the larger pelagic young ones of *Drepanopsetta*, namely MALM: "Kgl. Sv. Vet. Acad. Handl. Bd. 7, No. 4, 1868" has misidentified them as young *Pl. limanda*. In his "Fauna 1877, pg. 510" he himself draws attention to this fact; one of his proofs, that the dorsal fin counts 78 rays and the anal fin 57 is however not absolutely conclusive, but April being the time of their capture in Bohuslän's Skærgaard makes it very probable that they belong to *Drepanopsetta* and not to *Pl. limanda*.

HOLT's work which is referred to above is called: "On the Eggs and Larval and Post-Larval Stages of Teleosteans". (Scient. Trans. Royal Dublin Society Vol. V, Ser. II—III, 1893, Pl. I—XV.) He produces here on 15 plates a number of drawings of young fishes, masterly executed by himself; these drawings have considerably contributed to the knowledge of the young of flounder-fishes, but as he remarks himself, the identification has been no easy matter, especially of *Pleuronectidæ*. I suppose that several of the incorrect determinations, which he always puts down with great doubt and much reservation, are in the first instance owing to the fact, that he has caught but one doubtful specimen of *Drepanopsetta*, namely his fig. 120; this he has determined as *Pl. microcephalus* on account of its pigmentation which somewhat reminds one of the larvæ of this species (vide ante). For this reason, HOLT thought that *Drepanopsetta* was to be looked for among the other young specimens of the collection, and believed he had found them among the highly varying young *Pl. limanda*; though he, as before mentioned, has been rather doubtful regarding this subject. However, all the fishes that HOLT represents loc. cit. as *Drepanopsetta*

figs. 98—103, are not *Drepanopsetta* but *Pl. limanda*. Owing to the great obligingness of HOLT, for which I also want to thank him here, I have had the opportunity of examining several of the original specimens from which his figures were drawn in the mentioned paper of 1893. The originals of the fig. 100 and 101 l. c. were, according to the low number of precaudal vertebræ, *Pleuronectes limanda* not *Drepanopsetta platessoides*. (See pag. 11.)

The very earliest stages excepted, all the literature with which I am acquainted consequently, does not offer more than merely sketched illustrations (by MALM, KYLE and myself) of the older pelagic young of *Drepanopsetta*. I therefore consider it necessary to present here a complete series to connect the younger stages with those quite transformed; they will moreover, serve as a proof of the correctness of my determination of the young *Drepanopsetta*, and last though not least, they may in future contribute to prevent mistakes in identifying *Pl. limanda*, *Pl. microcephalus* and *Drepanopsetta*, the two latter being in reality easily recognizable even without counting either vertebræ or fin-rays, where we have to deal with fairly well-preserved specimens. —

The eggs of *Drepanopsetta*, so easily recognizable from most other pelagic fish-eggs on account of their large perivitelline space, are beautifully represented e. g. by HOLT (loc. cit. Pl. VII, figs. 57—59) (see my figs. 1 and 2, Pl. I after HOLT). At Ireland, HOLT states the size of those caught in "tow-nets" to be 2,64^{mm}; at Scotland, M'INTOSH reports the size rather smaller, but at Iceland they reach a size of 2,7—3,2^{mm}. Such eggs have been hatched on board the steamer "Thor" by JOHS. SCHMIDT. The larvæ, which measured 5—6^{mm} are quite in accordance with those of HOLT (loc. cit. Pl. VII, figs. 60—61), they are reproduced on my Pl. II, figs. 3 and 4; shortly after hatching, HOLT's specimens however, only measured ca. 4—5^{mm}. From these young ones up to the perfectly metamorphosed we have at hand complete series from Iceland. Pl. II, figs. 5—14 show all I have considered necessary to illustrate the series and render their determination sufficiently easy in future.

The earliest stages of the newly hatched fishes (fig. 3) show so little pigmentation that the larvæ are what I should call characterless; a few days older, however, whilst not yet 5^{mm}, 5 pigment-groups appear distinctly developed, 3 behind the anus, 1—2—3, one by the anus, 4, and one in the gastric region, 5; for this reason, the larvæ may be confounded only with *Pl. cynoglossus*, whose larvæ however are in this stage longer (c. 7^{mm}, see fig. 22, Pl. II); and particularly, the distance from the tip of the lower jaw to the anus is only $^1/_3{}^{rd}$ of the total length of the fish, whilst the distance in *Drepanopsetta* is more than $^1/_3{}^{rd}$. The following stages (Pl. I, fig. 5) of 9,5^{mm}, also resemble in pigmentation *Pl. cynoglossus* at the stage of 15^{mm} (Pl. II, fig. 23), but (1) these are very elongated and much longer than the larvæ of *Drepanopsetta*, and (2) they are without the remains of the pre-anal embryonic fin, which *Drepanopsetta* has in this stage (see Pl. I, fig. 5). This fin appears as a thin membrane between the rectum and the first bend of the intestine. At a length of 12—13^{mm} (Pl. I, figs. 6—7), *Drepanopsetta* shows a distinct *c* pigment-group, and does not at present in the very least resemble *Pleur. cynoglossus*; on the contrary, it might now be said to remind one more of the young *Pl. microcephalus*. From this it may be distinguished by the pigment dots on the fins, the limit of which is more distinctly marked in *Pl. microcephalus*, and the dots in the latter are stronger in colour. Besides, the vertical fin of *Pl. microcephalus* will be found much broader and the mouth much smaller (see the figures Pl. II). At a length of 12—13^{mm} (Pl. I, figs. 6—7), not a few changes have taken place from fig. 5; the pigment-groups 2 and 3 divide each into a dorsal and a ventral group, and a bipartite *c* group appears. Slight pigment-dots appear in the vertical fins opposite 2, 3 and c, and fin-rays begin to develop in these fins. By comparing these figures with the following ones, it will be seen that the farthest back pigment-group 1 must be counted to the region of the caudal fin and is effaced more or less. The 3 other pigment-groups 2, 3 and *c* remain on the contrary constant and in two part; on the fins opposite these groups appear 3 other pairs, 3 dorsal and 3 ventral ones. Later on (Pl. I, fig. 10) another, 4, dorsal one appears in front of the 3 others, and Pl. I,

fig. 11 shows a 5th dorsal dot together with a 4th and 5th anal one; so we possess already in these pelagic stages the recognizable pigment-groups of the bottom stages (Pl. I, figs. 12, 13, 14), which may essentially be recognized in the grown-up fish. At a length of 12—13mm, the true caudal rays begin to develop and the proportionately long urochord to bend upwards; the proportions rather remind one of the tail of a larval *Zeugopterus*. The pre-anal embryonic-fin has disappeared, the mouth is large enough to gape over an object the size of the eye, the body becomes higher, the ventral region more prominent, the frontal profile more and more concave, but still the fish is quite symmetrical and may remain like this up to a length of 18mm (see Pl. I, fig. 8). At a length of 34mm the fishes may still have a pelagic appearance, though they perhaps now live near the bottom (see Pl. I, fig. 11). The left eye is still situated on the left side of the head, but is now very close to the dorsal ridge. Pl. I, figs. 9 and 10 show all transitional stages from the smaller fishes up to these large ones of 34mm. In the latter the ventral region is no longer very prominent, the right side shows more pigment than the left, the body is still quite devoid of scales and rather high, the eyes quite circular and small, the pectoral fins large but perfectly larval, that is without true rays. Not until the stages of incipient scale-development along the lateral line (see Pl. I, fig. 12 and 13, which represent decidedly bottom-fishes), does *Drepanopsetta* become gradually, with regard to pigmentation, body-form, scale-covering, form and size of the eyes and development of the pectoral fins, like the grown-up fish. Pl. I, fig. 14 shows a completely metamorphosed *Drepanopsetta* of 39mm.

Pl. I, fig. 13 shows the very small pectorals and small eyes, but otherwise it closely approaches the completely metamorphosed fish; it rather corresponds with Holt's fig. 104, whilst his fig. 105 is quite like the grown-up fish. His fig. 104 has been drawn from a specimen of 27mm. The corresponding stages at Iceland are — at least as a rule — of a more considerable size, 35—40mm. On the whole there is evidently a great difference in the size at which the metamorphosis of *Drepanopsetta* takes place in different seas. At Iceland and the north of Norway I have seen specimens not metamorphosed and partly still pelagic up to a length of 35mm, whilst in Denmark the corresponding ones only measure 22mm. From Denmark I have a completely metamorphosed *Drepanopsetta* only measuring 28mm, whilst the corresponding ones at Iceland are much larger. We must remember that *Drepanopsetta* as full-grown is larger and its number of fin-rays considerable higher in the North than in the South (see Collett: "The Norwegian North-Atlantic Expedition. Zoology. Fishes 1880"); this is quite in accordance with the fact, that its eggs are larger at Iceland than at Ireland and in Denmark, and that its pelagic fry is larger there than here.

It may perhaps be noticed that Pl. I, fig. 13 has been drawn from a specimen of 31mm, and fig. 12 from one of 35,5mm; all the same, I consider the shortest specimen more advanced in development because its body-form approaches much more that of the completely metamorphosed fish (Pl. I, fig. 14); its eyes are rather larger, and the characteristic reduction in size of the pectoral fins, which can distinctly be traced in the whole series of figures, is more advanced than in the specimen fig. 12. I shall leave unsettled, whether it be a rule that the size of the whole fish is reduced by the transition from stages like fig. 12 to stages like fig. 13, as this can only be proved from very large material.

The stage fig. 12 without the embryonal pectorals might very well, in a hurry, be taken for a completely metamorphosed plaice of the same length, 35,5mm; superficially seen there is some resemblance. —

The young *Drepanopsetta* collected at Iceland and Denmark are preserved in 2 % Formalin, which seems to be an excellent fluid to preserve pigment as well as form; the objection may perhaps be raised, that 2 % makes the pelagic young ones shrivel up too much.

I have seen pelagic young ones kept in spirit from other places, in development and size corresponding to fig. 11, Pl. I, and their entire form, especially the head, had asumed quite a changed aspect through this treatment, the front-profile being quite changed from convex to concave. I beg this to

be remembered in future comparisons between such young ones and my figures. It is quite right that the front profile forms a concave line in the stages fig. 7, 8 and 9, Pl. I, but the concavity disappears when the left eye approaches the dorsal ridge as in the following stages; by preservation in spirit however it can be reproduced.

Pleuronectes microcephalus.

The quite early stages of *Pl. microcephalus* in which the yolk has just been absorbed are well known; we find them for instance, beautifully illustrated by HEINCKE and EHRENBAUM: "Wissensch. Meeresunters. Bd. III, Taf. X", and in "Food Fishes Pl. XV, fig. 9". Young ones quite in accordance with those of EHRENBAUM, fig. 34, were hatched on board the steamer "Thor" at Iceland by JOHS. SCHMIDT. The eggs were caught by tow-netting. These young ones measured 4,7^{mm} (see Pl. II, fig. 15). They have behind the anus 3 pigment groups, 1, 2 and *c*, the last one is only ventral. Besides these, they have more or less pigment-groups along the margin of the dorsal and anal fins. The breadth of the fins together with the absence of the pre-anal embryonic fin furthermore serve to distinguish them from the corresponding stages of *Drepanopsetta*. The distance between the tip of the lower jaw and anus is larger than $^1/_3{}^{rd}$ of the total length, a character that separates them from all young ones of *Pl. cynoglossus* with which they can hardly be confounded. The pigment spots on the margin of the vertical fins are constant in their appearance in all young ones of *Pl. microcephalus* I ever saw, from the earliest stages up to the older ones; they already appear in fishes of 7—8^{mm} just opposite the corresponding spots on the body, so that the fish gets a peculiar striated appearance. Similar figures have been given by M'INTOSH and MASTERMAN in Food Fishes Pl. XV, fig. 12—13 and by KYLE loc. cit. Pl. XI, fig. 28, but in several other figures these pigment spots on the fins are not drawn at all. The above mentioned young specimen represented by HOLT, loc. cit. fig. 120, must probably be referred to *Drepanopsetta* e. g. on account of the form of the tail which is quite unlike that of *Pl. microcephalus* at the corresponding stage. On the same Pl. XV, figs. 121—122 HOLT figures on the other hand a larger young fish of 27^{mm}, which still show traces of the peculiar pigmentation and is a true *Pl. microcephalus*. I have reproduced his fig. 121 on my Pl. II, fig. 21. The lack of pigment-patches on the fins as well as the many indistinguishable drawings in literature, with regard to which I shall not enter into details, may perhaps be ascribed to bad preservation, but I fail to understand how M'INTOSH and MASTERMAN loc. cit. Pl. XVII, fig. 3 can figure a typical young *Pl. microcephalus* as a *Pl. flesus*, the more so from the fact that they usually know *Pl. flesus* in the earlier as well as in the older stages.

My figure Pl. II, fig. 16 represents a larval *Pl. microcephalus* of 10^{mm} which still shows the same arrangement of pigment spots on the body as fig. 15, but the pigmentation is more developed on the fins and quite a new spot has appeared on the anal fin, ventrally, opposite to a. The marginal fins have become broader, the caudal fin has just begun to get its true rays. The following figures 17—20, of which 3 have been drawn from specimens captured at South Iceland, and fig. 20 from a specimen from the Fœroe Isles kindly sent me by JOH. HJORT, show the development of the pigmentation, the fins and the whole body approaching HOLT's fig. 121 (my fig. 21 pl. II) of 27^{mm}. A more detailed description of this species I consider superfluous. Even HOLT's specimen 121 still shows larval pectorals. I have never found older stages; such would however hardly be difficult to identify. The height of the body, the small head and mouth together with the character that the vertical fins closely approach the caudal fin-rays, are characteristic features. Such stages have been figured by "Goode and Bean".

Pleuronectes cynoglossus.

The eggs of *Pl. cynoglossus* have not been found at Iceland by the "Thor" on its cruise, at any rate they have not been hatched. The smallest young ones that were captured had a length of 5,6^{mm}. They

are both in form and pigmentation on the body and the fins, in accordance with HOLT's fig. 75, l. c. 1893 (reproduced Pl. II, fig. 22). It has been drawn from a hatched young specimen ca. 10 days old. Thus we have here an authentic young one of the pole dab, which cannot be said of his figs. 71—72 and 74; we have in this fig. 75 a proof of the right determination of our small young ones. Besides this we have another just as convincing proof, namely an almost unbroken series from these small young ones up to the almost metamorphosed and easily recognizable pole dabs of 48mm. The largest specimen of this series, for the loan of which I am under obligation to JOH. HJORT. measures 48mm, whilst our own longest were only of 42mm; even the specimen of 48mm has still quite larval pectorals. From these specimens to those of 70—80mm, captured by A. C. JOHANSEN on board the "Thor" in the depths of the Skagerak in the spring of 1904, and which are supposed to belong to the O-group, there is a great break. These latter are essentially, except in pigmentation and size, like the grown-up ones, so I have not thought it necessary to figure them, but shall refer to HOLT's fig. 123 drawn from a specimen of 42mm (reproduced on Pl. II, fig. 28). The specimen is quite beyond the larval stage and has well developed pectoral fins. From this it appears that the larval stage comes to an end at a considerably smaller size at Ireland than in the Skagerak and the more open northern seas. This may perhaps also be subject to some variation, as I know from Norway a completely metamorphosed specimen of 45mm (see "Beretning IV" fig. 14). A reduction in size may possibly take place by transition from the larval to the postlarval stage; about this however, my material does not give reliable information.

The whole series represented on Pl. II, figs. 22—28 leads from the newly hatched young of ca. 6mm fig. 22, to the very elongated ones of ca. 15mm (fig. 23) with the peculiar backwards pointing rectum, through stages as figured by H. M. KYLE in "J. M. B. A. Vol. VI, 1903" of 12—14mm, and further on, to that of 27mm with spines on the preoperculum represented by HOLT in "Scientific Investigations, Ireland Pl. III, 1903". Fig. 26, Pl. II very much resembles the specimen figured by me in "Beretning IV". It has small spines on the preoperculum, measures 31mm and is quite symmetrical. Pl. II, fig. 27 has been drawn from a specimen captured in the Skagerak, November 1903, at 100 fathoms. Preoperculum is faintly provided with spines on the edge; it seems as if they were going soon to disappear; the migration of the eyes has not yet been completed, the pectorals are large and larval, but the shape of the mouth together with the whole appearance of the fish refers this stage without any doubt to *Pl. cynoglossus*; it leads through fig. 28 directly to the grown-up fish with all its characteristic features. Whilst at present, it is beyond doubt that stages like those fig. 26 belong to *Pl. cynoglossus*, a fact that HOLT in his above quoted paper also regards as unquestionable, it was not possible for me to settle this formerly, because I only knew one specimen similar in shape to fig. 26. Its large mouth and spines made me suppose that it could not belong to the genus *Pleuronectes* and the number of rays in the dorsal and anal fins respectively of ca. 100 and 88, also made me doubt this (see the table this paper pg. 10).

With regard to the identification of the earliest stages, the characteristic pigmentation as well as other features have already been considered in this paper. Here I shall only recal that stages like fig. 23 present no trace of a pre-anal embryonic fin like the corresponding stages of *Drepanopsetta*, that they are much longer than the young *Drepanopsetta* and that the post-anal part of the body measures at least $^2/_3$rds of the total length.

Pleuronectes platessa, flesus and *limanda.*

Regarding the determination of the plaice, the flounder, and the common dab I shall here content myself with the following remarks. As to the earliest stages, I shall amongst others refer to EHRENBAUM's work No. I in "Wissenschaftl. Meeresunters. II Bd.". The larger pelagic stages of the dab are

well represented by HOLT as *Hippoglossoides platessoides* figs. 100 and 101, and EHRENBAUM's figs. 14—15. Pl. IV l. c. gives a good representation of the larger pelagic plaice. These latter may still in later stages resemble the dab. I have myself of late years found pelagic plaice of 14mm in the Kattegat with a pigmentation much resembling that of the dab. Like EHRENBAUM I can therefore at present find a reliable distinguishing character between them only in the number of precaudal vertebræ. For this reason I am also unable to give my opinion about HOLT's figs. of the pelagic stages of the plaice, because he does not state the number of vertebræ. His fig. 112 of *Pleur. limanda*, the original of which I have investigated myself, is however a plaice, it had 13 precaudal vertebræ. Regarding the bottom-stages I shall refer to my two older figures in "Beretning IV". The large eyes and the more elongated body in the dab may here aid the identification till the form of the lateral line becomes conclusive.

In respect to the flounder: its lesser size through all transition stages, and later on the number of fin-rays together with the spines on the interspinal bones are characteristic features. To show the limits within which the number of vertebræ in Danish waters (The Belts) may serve as a distinguishing mark between the plaice, flounder, dab and long-rough dab, I add the following table, results of A. C. JOHANSEN's and A. OTTERSTRÖM's counting of vertebræ.

Plaice		Flounder	
Vertebrae without and with lower arches	Number of specimens investigated	Vertebrae without and with lower arches	Number of specimens investigated
12 + 30	2	10 + 23	2
12 + 31	1	10 + 24	2
13 + 28	1	10 + 25	3
13 + 29	9	11 + 22	1
13 + 30	11	11 + 23	5
13 + 31	1	11 + 24	57
		11 + 25	31
		11 + 26	3
		12 + 23	4
		12 + 24	4
		12 + 25	1
Dab		**Long-rough dab**	
9 + 31	1	12 + 32	9
10 + 29	3	13 + 33	9
10 + 30	15	13 + 31	2
10 + 31	4	13 + 32	8
11 + 29	1	13 + 33	9

Between the plaice and the dab the number of precaudal vertebrae affords a good distinguishing mark, as a rule the number is respectively 13 and 10. The total number of vertebræ is small in *Pl. flesus* and considerable in *Drepanopsetta*. The small number of fin-rays in the median fins of *Pl. flesus* (see "Beretning IV") afford however an easier and more applicable distinguishing character. The number of fin-rays in *Drepanopsetta* (see p. 10) may be very considerable, but is rather variable in different seas; great caution is therefore necessary when employing this as a distinguishing character. Between plaice and long-rough dab the above named numbers hardly afford any characteristic. —

I cannot finish this treatise without drawing attention to the great difference existing between many young fishes of the same species at Iceland and on the whole in the more open waters, and those captured in the Danish inshore waters, especially with regard to the dab and the long-rough dab. The

larval stages become larger in the open seas and have another appearance, the pigmentation is also often more pronounced. It is an often recognized fact, when sufficient material is at hand, that fishes of the same species differ in the different areas. This holds good for many species, others may be more constant. Similar features are evidently met with in all other divisions of the animal kingdom. Formerly, I have often had occasion to notice this among the molluscs. Among naturalists such local differences have been studied with great energy, for instance with regard to the plaice, and especially to the herring by Fr. Heincke. These variations which may deeply concern the whole organisation of the fish (number of vertebræ, fin rays etc.) and the development in the earlier as well as in the later stages, are beyond any doubt, but no light has yet been thrown over the great question, — to what degree the yare hereditary and independent of the surrounding conditions (races), or if the ymay be produced directly by these latter (forms, local forms). It is quite impossible from the appearance of a specimen to form an opinion with regard to the appearance of its parents, so long as we do not know if the local characters be hereditary or not. It is to be hoped that the experimental investigation set forth on the program of the International Commission C. 2, will result in new facts concerning this question. The just comprehension of this matter will be of the greatest importance in understanding the relationship between the stock of fishes in different seas, indeed it may be said to be of the highest significance both theoretically and practically.

When I lay so much stress on the knowledge of the earlier stages of fishes in order to keep them clear of each other, it comes from the conviction, that we can by no means always expect to find all stages represented in the same waters where we find some of them. It has always been regarded as settled, at least in the older literature, that where the adult fishes of a species occur, their young ones will always appear in all stages. My researches, continued through 20 years, after such complete series have taught me, that it is by no means a rule to find complete series or at any rate only a rule with very many exceptions, and these exceptions especially apply to the larger and therefore, from an economical point of view, more important species. We know that the cod does not pass all its stages of life in all places where it occurs in numbers, and we already possess the same knowledge concerning the plaice and the eel. My conviction is, that a thorough investigation of this matter would add considerably to our knowledge of the life history of all the more important species. It has struck me as a peculiar feature that the young stages of *Pl. cynoglossus* as well as those of *Pl. microcephalus*, which have now been collected in great numbers in more open waters, in the same manner of fishing as that used by myself, do not at all occur in the veritable Danish waters inside Skagen, though these fishes when grown up are very common here, and *Pl. cynoglossus* especially is captured yearly in considerably numbers in the Kattegat. I shall however abstain from a more detailed mention here of the geographical distribution of these and other larval stages; it will perhaps be the subject for a later publication.

April 1904.

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550 12/VIII 1904

Plate I.

Drepanopsetta platessoides.

Fig. 1. Egg from tow-net. Holt, fig. 58.
„ 2. „ „ „ „ „ 59.
„ 3. From tow-net. About half a day old ca. 4mm. Holt, fig. 60.
„ 4. Older larva from tow-net. 4,65mm. Holt, fig. 61.
„ 5. North Iceland. June 15. 1903. Young-fish trawl; surface. 9,5mm.
„ 6. West Iceland. June 10. 1903. „ „ „ „ 11,5mm.
„ 7. „ „ July 4. 1903. „ „ „ „ 12,5mm.
„ 8. „ „ „ „ „ „ „ „ „ 17,5mm.
„ 9. „ „ „ „ „ „ „ „ interm. depth, ca. 24mm.
„ 10. South Iceland. July 11. 1903. „ „ „ 31,5mm.
„ 11. S. E. Iceland. July 20. 1903. „ „ „ on bottom 34mm.
„ 12. South Iceland. July 19. 1903. „ „ „ „ „ 35,5mm.
„ 13. „ „ „ „ „ „ „ „ „ „ 31mm.
„ 14. East Iceland, Seydisfjord. May 24, 1903. English trawl. 39mm.

Plate II.

Fig. 15—21. *Pleuronectes microcephalus.*

Fig. 15. Fœroe Isles. Hatched on board. August 21. 1903. 4,7mm.
„ 16. South Iceland. Young-fish trawl; surface. July 18. 1903. 10mm.
„ 17. „ „ „ „ „ „ „ „ „ 13mm.
„ 18. „ „ „ „ „ „ „ „ „ 14,5mm.
„ 19. „ „ „ „ „ „ „ „ „ 15mm.
„ 20. S. W. of Fœroe Isles. Taken by "M. Sars"; near the surface. August 15. 1902. 18mm.
„ 21. From Holt's figure 121. 27mm.

Fig. 22—28. *Pleuronectes cynoglossus.*

Fig. 22. From Holt's figure 75, ca. 10 days old, ca. 5,6mm.
„ 23. Shetland. September 11. 1903. Young-fish trawl. 200 meter wire out. 15mm.
„ 24. „ „ „ „ „ „ „ „ „ „ „ 18mm.
„ 25. „ „ „ „ „ „ „ „ „ „ „ 21mm.
„ 26. „ „ „ „ „ „ „ Surface. 31mm.
„ 27. Skagerak. November 19, 1903. 100 fathoms. Young-fish trawl; on bottom. 42mm.
„ 28. From Holt's figure 123. 42mm.

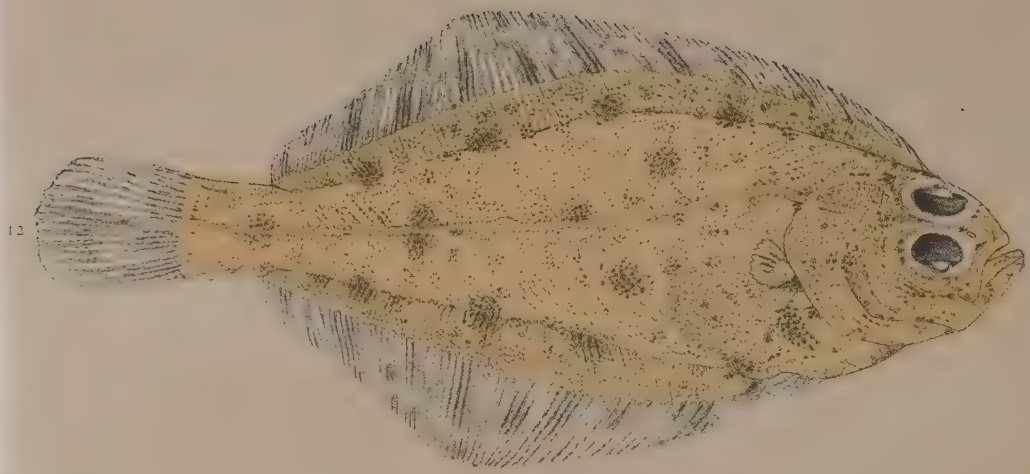
Fig. 5—20 and 23—27 are drawn by reflected light under a camera lucida.

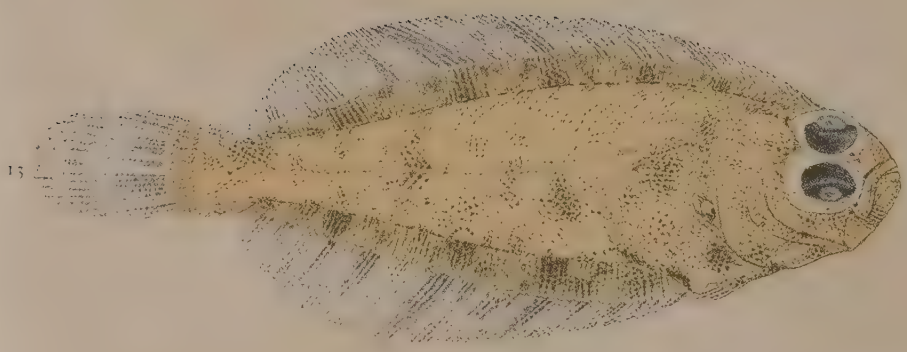
Fig. 6—14, Pl. I are drawn with a magnifying pover of ca. 4,5.

A young-fish trawl is a trawl made of "stramin", especially constructed by myself.

The buff ground colour on the figures is used simply for purposes of shading, and to denote the relative opacity of parts.

WESTERGAARD DEL.





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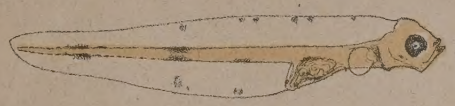
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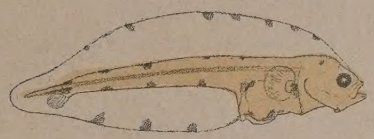
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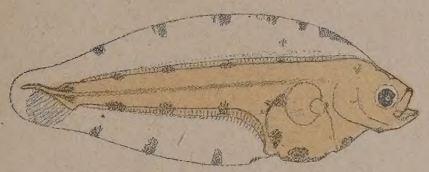
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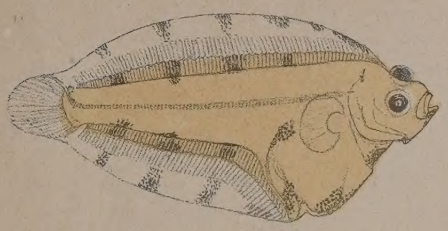
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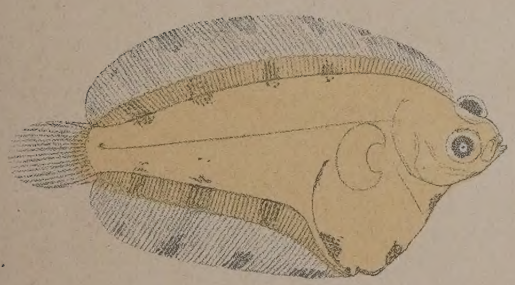
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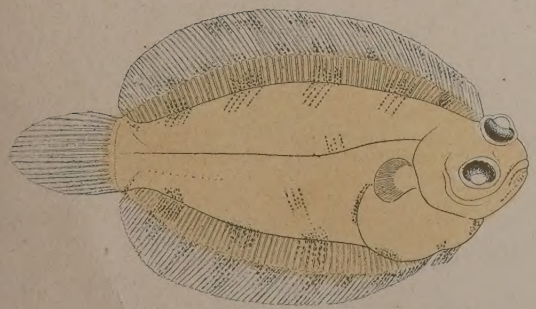
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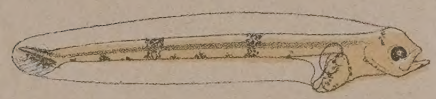
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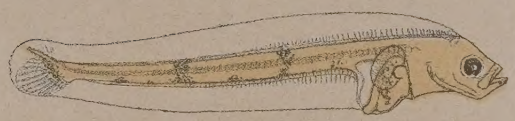
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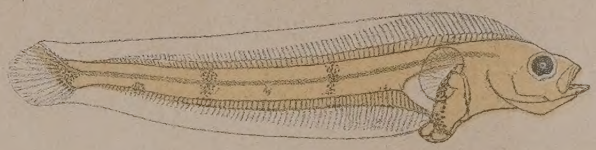
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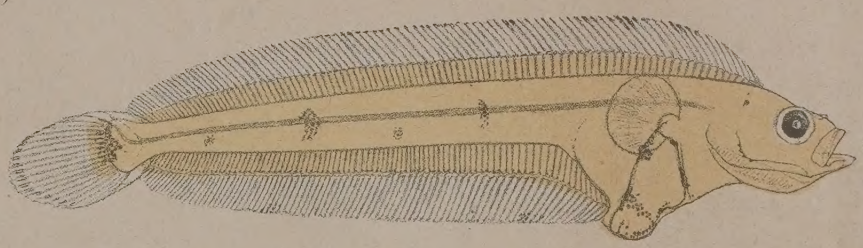
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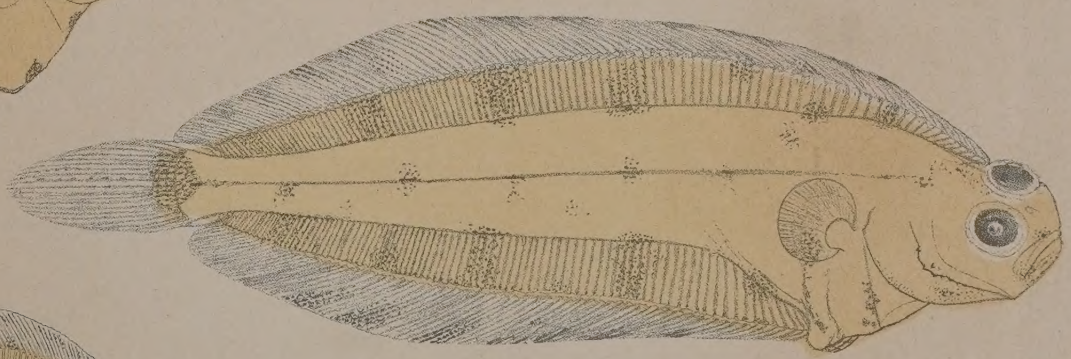
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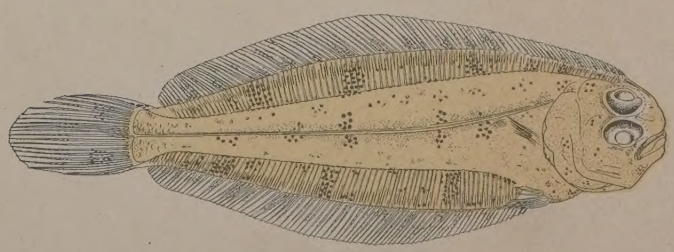
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